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Does prior knowledge benefit Mandarin-speaking older adults' memory consolidation in Cantonese tone learning?

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Sleep supports young adults' perceptual learning of nonnative speech categories through memory consolidation (i.e., memory is preserved better during sleep than during waking) [1]. Research showed that newly learned information aligned with prior knowledge was consolidated more rapidly than that does not [2]. In Mandarin-speaking young adults' Cantonese tone learning, prior knowledge was manipulated according to L1 [3]. The pitch contour cue in the Cantonese contour-level contrast (henceforth, contour tones) is consistent with their prior L1 knowledge, while the pitch height cueing the level-level contrast (henceforth, level tones) is not as L1 lacks the contrast. They consolidated contour tones better than level tones (i.e., improved in the trained-talker posttest after sleep). Older adults, however, forgot equally in both intervals due to age-related changes in consolidation and sleep [4]. Given the age-related deficits in memory consolidation, this study examined whether prior knowledge would benefit tonal consolidation among older adults.

Following the design of [3], 60 Mandarin-speaking older adults (aged 55-78) were recruited (Fig 1). 30 participants were trained to learn Cantonese contour (T5 vs. T6 cued by pitch contour, aligned with their prior knowledge) and level tones (T3 vs. T6 cued by pitch height, not aligned) produced by a male talker in the evening (with sleep after training), while 30 trained in the morning (without sleep), which followed by three posttests: immediate identification (ID1), 12-hour delayed ID2, and novel-talker (female) ID3. A Fitbit recorded sleep to test whether it facilitated learning [5].

Two mixed-effects logistic regression models were run on accuracy. Three variables, Posttest (ID1/ID2/ID3), Group (Evening/Morning), and Tone (Contour/Level), with by-subject random slope and intercept, were entered in the models. The model regarding ID1 and 2 did not yield a three-way interaction (Fig 2). Crucially, the one involving ID2 and 3, revealed a three-way interaction (Fig 3). Post-hoc analysis indicated, in contour-tone learning, the evening group did not show a difference between ID2 and ID3 ($z=0.62$, $p=.53$), but others exhibited lower accuracy in ID3 than in ID2 (Contour-Morning, $z=4.74$, $p<.001$; Level-Evening, $z=4.53$, $p<.001$; Level-Morning, $z=5.40$, $p<.001$). It suggests a generalization between trained and novel talkers for contour tones in the evening group. Sleep parameters positively predicted the generalization effect (ID 3-2; in Fig 4).

Unlike young adults (aged 19-33) showing a beneficial effect of prior knowledge on memory consolidation by improving performance in the trained-talker posttest after sleep [3], older adults benefited through talker generalization (although nonnative tones are challenging for L2 learners due to significant variabilities across talkers [6], compared to other speech categories [1]). This study further demonstrates the role of prior knowledge in memory consolidation across the lifespan.

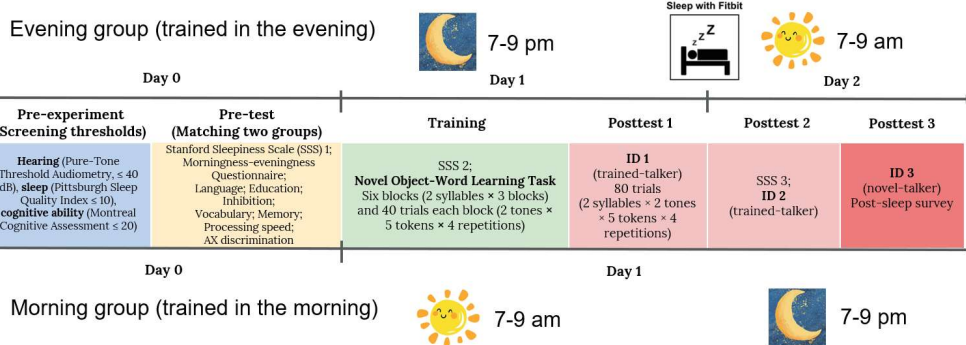


Figure 1 Experimental procedure

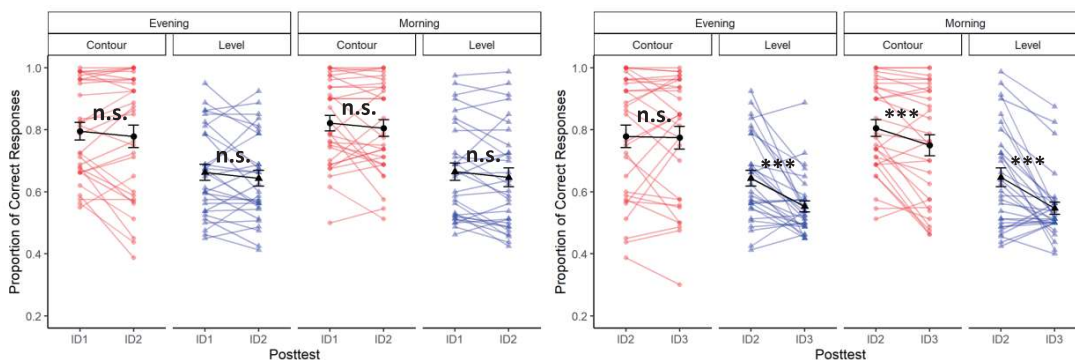


Figure 2 Accuracy in ID1/2 (immediate vs. 12-hour)

Figure 3 Accuracy in ID2/3 (trained vs. novel talker)

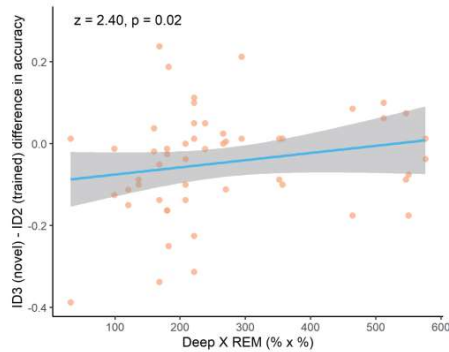


Figure 4 Sleep parameters (percentage product of Deep X REM) positively predicted the ID3-ID2 difference in accuracy (novel-trained talkers). Deep: deep sleep (Stage 3 of non-rapid eye movement sleep); REM: rapid eye movement sleep

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